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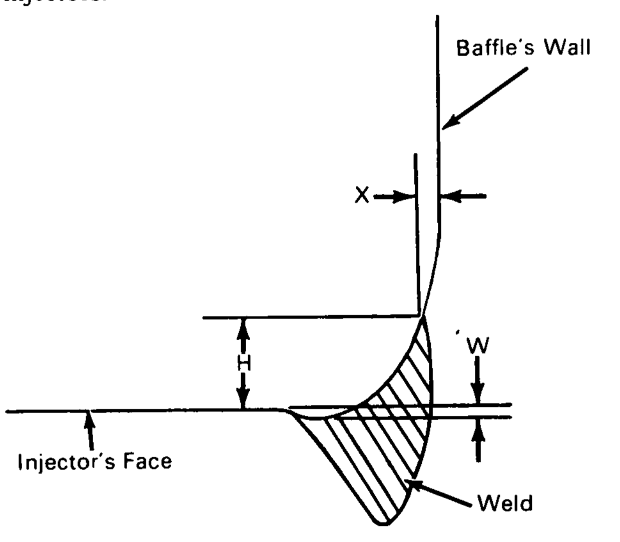
NASA TECH BRIEF

Nondestructive Assessment of Penetration of Electron-Beam Welds

A newly developed and verified empirical method correlates penetration of an electron-beam weld with external measurements of the weld. Verification of adequate penetration, by conventional methods of inspection, is often prevented by the complexity of welded components—as when baffles are welded to injectors.



Dimensions X, H, and W

Comparison of cracked and intact baffle-injector welds, after identical hot-fire exposure, showed that failure results from poor penetration. Cracking follows thermal cycling that loads the weld in shear and compression alternately; when penetration is incomplete, thermal loads are magnified beyond critical levels and eventually fracture the welds.

Comparison of external dimensions with penetration of welds led to evolution of an empirical polygon that accurately confirms full-penetration welds. Allowance for the lower strength requirements for welds near the baffle's tip resulted in evolution of a second polygon, larger than the first, that provides for penetration of welds near the tip. Finally the acceptance polygons were made smaller so that prediction would be more conservative.

The key external dimensions were: X, distance from the baffle's wall to the beginning of the baffle-injector attachment weld; H, distance from the injector's face to the weld line on the baffle; and W, distance from the injector's face to the low point in the weld (below the plane of the injector's face) (see fig.). Not all injectors show W.

Tabulation of weld dimensions from available injectors revealed that two did not meet the acceptance-polygon requirements. Sectioning of these two confirmed the faults predicted from the external measurements.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
Manned Spacecraft Center, Code BM7
Houston, Texas 77058
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Patent status:

No patent action is contemplated by NASA.

Source: T. J. Harmon, M. C. Yost, and J. L. Hillman of North American Rockwell, Inc. under contract to Manned Spacecraft Center (MSC-15955)

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